LIVESTOCK WATER SUPPLY

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The simultaneous availability of range and water is essential for pastoral development. The range and surface-water resources depend directly on the rainfall pattern. Groundwater resources depend not only on rainfall, but also on the infiltration and storage capacity of the ground.

As there are no permanent streams outside the Nile river, and as the rainy season lasts only a few months, the livestock water supply relies mostly on groundwater. Therefore, the availability of groundwater and its development through wells and boreholes are of great importance for livestock development.

The climate of the mapped area is subtropical to arid and is dominated by continental influences. Rainfall occurs mainly in summer and winter are dry. Rainfall varies from 600 mm in the southern part of the mapped area to less than 50 mm in the northern part. The interannual variability of rainfall is stronger towards the north. In recent years, Sudan has been affected by a prolonged drought; between 1965 and 1974, the annual average rainfall was10% less than the average of the preceding 30 years, producing a southward shift in the isohyets of 75 to 100 km.

Most of Sudan lies within the drainage basin of the Nile, which traverses the country from south to north. The Nile and its main tributaries, the Blue Nile and White Nile, are the only perennial watercourses. They have had a dominant influence on the economic and social history of the country, including of course the livestock sector.

At the confluence of the White and Blue Niles at Khartoum the Blue Nile contributes some 84% of the flow of the Nile and originates in the Ethiopian Highlands. The White Nile enters the southern border from Uganda and provides about 16% of the Nile flow. North of Khartoum, the Nile is joined by the Atbara, which also originates in Ethiopia, before crossing the Nabri desert into Egypt. In the south, the White Nile is joined from the west by the Bahr el Ghazal and Bahr el Arab; the upper reaches of the latter drain the eastern slopes of Jebel Marra (wadis Bulbul, Kaya, and Ghendi). Above the confluence with the Bahr el Ghazal, the white Nile is known as the Bahr el Jebel. An extensive area of swamp, the Sudd, occurs at this confluence.

Two other important watercourses enter Sudan from Ethiopia: Khor el Gash and Khor Baraka. Both have seasonal flood regimes. Khor Baraka enters the Red Sea at Tokar delta.

Several wadis drain the Red Sea Hills towards the Red Sea, including Khor Arbaat, Khor Mog and Khor Handoub. These have intermittent flow regimes.

Seasonal wadis in Darfur in west Sudan form part of the Chad basin. These include the Wadi Azum that drains the western slopes of Jebel Marra.

The dry northeastern part of the country lacks surface water. The flow of the seasonal rivers depends on rainfall that occurs spasmodically in the wet season and is often extremely intense and localized. The resulting river flows are similarly spasmodic, run off occurring for periods that can last from a few hours to several days. Between run off episodes, the rivers are usually dry for long spells, even during the wet season. Therefore, these floods do not constitute a reliable water supply for the livestock. About 75% of the livestock is reared by nomadic or semi-nomadic population, mainly in areas away from the Nile and thus depending extensively on groundwater supplies.

GROUNDWATER RESOURCES

The distribution of the major groundwater units of the mapped area is shown on the hydrogeological map at scale 1/5,000,000 **(Map 1)**. The major aquifers in order of decreasing importance are :

- the Nubian Sandstone formation,
- the Umm Ruwaba and associated formations,
- Alluvium and wadi fills,
- the Basement Complex.

The characteristics and potential of the aquifers are described in the legend as well as in the attached table. **Map 2** provides more information on the twelve main sedimentary basins, concerning groundwater quality and flow directions. These basins have the highest potential for groundwater development and therefore a high pastoral potential. Groundwater development is more difficult and limited in the areas of Basement Complex, although modern investigation techniques should improve significantly the result of exploration in this kind of environment.

WATER RESOURCES DEVELOPMENT FOR LIVESTOCK

As said before, surface water cannot be a reliable resource away from the Nile river. However, rainfall and run off water is collected in numerous reservoirs constructed in clay, called *"hafirs"*, or behind small dams.

Groundwater is extracted traditionally from dug wells, equipped or not with pumps. From the end of the sixties, groundwater has been developed for domestic and livestock water supply through the construction of thousands of "water yards". These consist of one or several drilled wells with six-inch casings and fitted with diesel pumps. The pumped water is stored in elevated tanks from where it flows to faucets to fill family buckets, and into three or four drinking troughs for livestock. The operation and maintenance of these three thousand or so "water yards", scattered on one million sq/km, turned out to be a very difficult task and many are now out over of order. Overgrazing around some of these sites is also a problem.

The locations of the water points (wells, boreholes, hafirs and dams) is plotted on the 1/500,000 scale rangeland maps, and their distribution is summarized on **Map 3**. Unfortunately no reliable information exists for eastern Sudan.

Table 1 - GENERAL HYDROGEOLOGICAL CHARACTERISTICS OF SELECTED ALLUVIAL AQUIFERS IN SUDAN

BASIN		WELL DEPTH (m)	DEPTH TO WATER LEVEL (m)	SPECIFIC CAPACITY (m^2/d)	TRANSMISSIVITY	PERMEABILITY (m/d)	STORATIVITY	ANNUAL RECHARGE (10^6 m^3)	ANNUAL ABSTRACTION (10^6 m^3)	TOTAL DISSOLVED SOLIDS (mg/ l)
KASSALA	K.El GASH	30	10	865	1 000	40	0.13	170/240	120	180/270
DARFUR	W. KUTUM	18	3.5	360	200	14	0.20	20	0.05	< 150
	W. AZUM	38	3	2 590	1 500	45	0.20	80	0.1	180/270
	W. ARIBO	20	1.5	2 590	1 000	50	0.25			< 150
	W. NYALA	17	2	865	600	50	0.20			< 150
	W. BULBUL	10,5	1.8	3 025	600	65	0.24	70	3	< 150
	W. KAJA	25	1	1 030	1 500					
	W. IBRA									
NORD	El SELEIM	< 50	6	3 460	500	10	0.15			120
	KERMA	< 50	5.7	5 620	1 050	12	0.15			120

Source UNDP, 1987

Table 2 - GENERAL HYDROGEOLOGICAL CHARACTERISTICS OF NUBIAN SUB-BASINS

BASINS	WELL DEPTH (m)	DEPTH TO WATER LEVEL(m)	THICKNESS	WELL YIELD (m^3/d)	SPECIFIC CAPACITY (m^2/d)	STORAGE (10^6 m^3)	ANNUAL RECHARGE (10^6 M^3)	ANNUAL ABSTRACTION ($10^6 m^3$)	TOTAL DISSOLVED SOLIDS (mg/l)
SAHARA						400	27	3	54/134
W. Howar	37.5	6	300+	445	1470				
Atrum	236	3,3	200+	490	2420				
Sanya Hayeih	96	53	100+	26					
Tima	106	67	50	145					
UMM KADDADA						600	100	10	80/666
Umm Bayada	94	25	70+	720	-				
Al Nusub	106	74	50+	390	-				
Umm Kaddada	70	33	200+	330	14				
Shagg Mamda	146	81	65+	330	10				
Shagera	263	44,5	164	590	535				
Sag El Naam	136	87	100+	530	1730				
Wad Banda	232	94	250+	120	20				
Sug El Camal	185	100	500+	288	25				
Fula	241	98	2000+	288	260				
NAHUD						2	16	5	160/280
Howag	280	132	150+	240	140				
Saata	310	95.4	200+		285				
Cefauvi	310	102	250	120	45				
Maya	357	111	250	120	25				
Iyal Bakhit	188	111	75+	120	105				
SAHARA NILE						600	175	35	200/700
Khartoum	65	20	100+	2040	345				
Kerma	245	6.2	500+	6730	820				
El Geleim	311	14.6	500+	3600	320				
W. El Milk	96	7.2	300+	410	215				
GEDAREF	130	50	206	385	10	76	40	8	940/2840
BARA						45	15	4	80/4580
UmmShelikeit	233	400	91	132	47				
Shawa	226	600	45.5	132	121				
Hedeid	137	2	70+	365	63				
Umm Ushra	233	600	200+	384	104				
Umm Sheila	121	76	100+	132	43				
ATSHAN						23	70	20	

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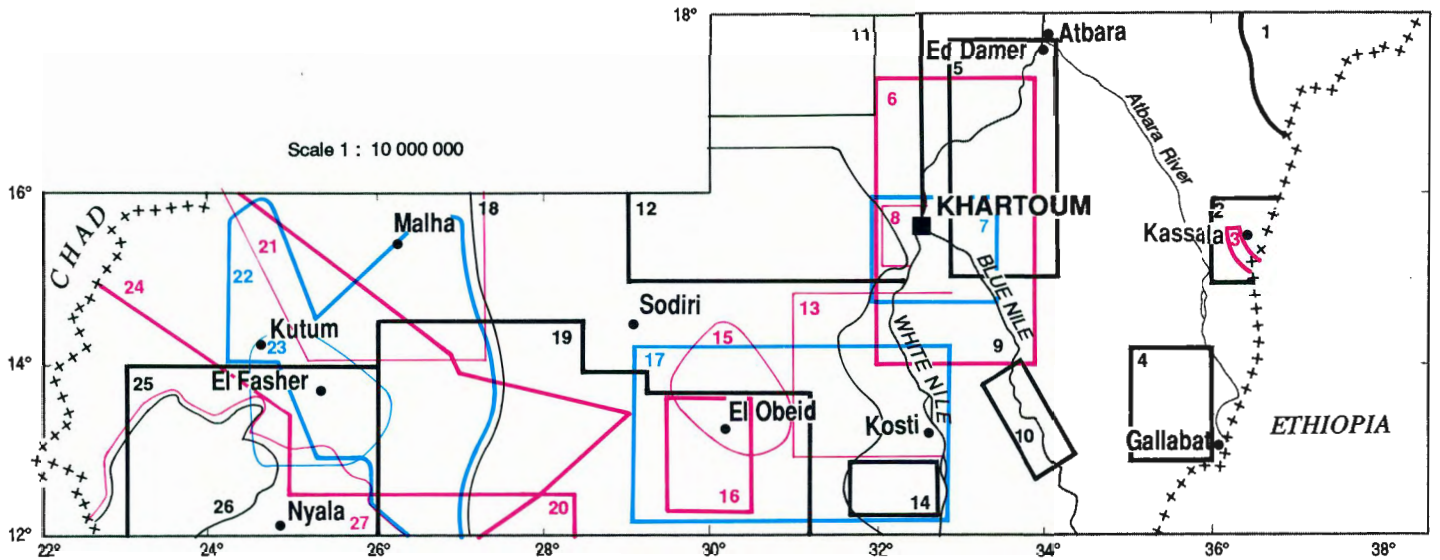
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